

WHAT IS CLAIMED IS:

- 1 1. An (R)-2,3-butanediol dehydrogenase, wherein
2 (a) the dehydrogenase produces (R)-acetoin by acting on (2R,3R)-2,3-
3 butanediol using nicotinamide adenine dinucleotide as a coenzyme and produces
4 (2R,3R)-2,3-butanediol by reducing 2,3-butanedione using reduced form of
5 nicotinamide adenine dinucleotide as a coenzyme;
6 (b) the dehydrogenase uses nicotinamide adenine dinucleotide as a coenzyme
7 in oxidation reaction and uses reduced form of nicotinamide adenine dinucleotide as a
8 coenzyme in reduction reaction and preferentially oxidizes a hydroxyl group of 2,3-
9 butanediol in (R) configuration; and
10 (c) the dehydrogenase has 100 U or higher of (R)-2,3-butanediol
11 dehydrogenase activity per 1 mg of the dehydrogenase when purified.

- 1 2. The (R)-2,3-butanediol dehydrogenase of claim 1, wherein the dehydrogenase
2 has (a) an optimal pH for glycerol oxidation reaction of 10; and (b) a molecular weight of
3 36,000 when determined by sodium dodecyl sulfate-polyacrylamide gel electrophoresis and
4 76,000 when determined by gel filtration.

- 1 3. The (R)-2,3-butanediol dehydrogenase of claim 1, wherein the dehydrogenase
2 is produced by a microorganism belonging to the genus *Pichia*.

- 1 4. The (R)-2,3-butanediol dehydrogenase of claim 3, wherein the microorganism
2 is *Pichia angusta*.

- 1 5. An isolated polynucleotide selected from the group consisting of:
2 (a) a polynucleotide comprising the nucleotide sequence of SEQ ID NO:1;
3 (b) a polynucleotide encoding a polypeptide comprising the amino acid sequence
4 of SEQ ID NO:2;
5 (c) a polynucleotide encoding a polypeptide that comprises an amino acid
6 sequence comprising the amino acid sequence of SEQ ID NO: 2 in which one or more amino
7 acids are substituted, deleted, inserted, and/or added and that is functionally equivalent to a
8 polypeptide comprising the amino acid sequence of SEQ ID NO:2; and

9 (d) a polynucleotide that hybridizes under stringent conditions to a polynucleotide
10 comprising the nucleotide sequence of SEQ ID NO: 1 and that encodes a polypeptide
11 functionally equivalent to a polypeptide comprising the amino acid sequence of SEQ ID
12 NO:2.

1 6. The isolated polynucleotide of claim 5, wherein the polynucleotide comprises
2 a nucleotide sequence having 70% or higher percent identity to the nucleotide sequence of
3 SEQ ID NO:1.

1 7. The isolated polynucleotide of claim 5, wherein the polynucleotide encodes an
2 amino acid sequence having 70% or higher percent identity to the amino acid sequence of
3 SEQ ID NO:2.

1 8. A substantially purified polypeptide encoded by the polynucleotide of claim 5.

1 9. The polypeptide of claim 8, wherein the polypeptide comprises the amino acid
2 sequence of SEQ ID NO:2.

1 10. A vector comprising the polynucleotide of claim 5.

1 11. A transformant comprising the polynucleotide of claim 5.

1 12. A transformant comprising the vector of claim 10.

1 13. A method for producing a polypeptide, the method comprising the steps of:
2 culturing the transformant of claim 11 and recovering an expression product.

1 14. A method for producing an (R)-2,3-butanediol dehydrogenase, the method
2 comprising: (a) culturing a microorganism that belongs to the genus *Pichia* and that produces
3 the dehydrogenase of claim 1 and (b) isolating the dehydrogenase from the microorganism.

1 15. A method for producing an (R)-2,3-butanediol dehydrogenase, the method
2 comprising: (a) culturing a microorganism that belongs to the genus *Pichia* and that produces
3 the polypeptide of claim 8 and (b) isolating the dehydrogenase from the microorganism.

1 16. The method of claim 14, wherein the microorganism is *Pichia angusta*.

1 17. A method for producing an alcohol, the method comprising the steps of:
2 reacting the (R)-2,3-butanediol dehydrogenase of claim 1 or a processed product
3 thereof to a ketone in the presence of reduced form of nicotinamide adenine dinucleotide to
4 generate an alcohol, and
5 recovering the generated alcohol.

1 18. A method for producing an alcohol, the method comprising the steps of:
2 reacting the polypeptide of claim 8 or a processed product thereof to a ketone in the
3 presence of reduced form of nicotinamide adenine dinucleotide to generate an alcohol, and
4 recovering the generated alcohol.

1 19. A method for producing an alcohol, the method comprising the steps of:
2 providing a microorganism producing the (R)-2,3-butanediol dehydrogenase of
3 claim 1 or a processed product thereof;
4 reacting the (R)-2,3-butanediol dehydrogenase produced from the microorganism to a
5 ketone in the presence of reduced form of nicotinamide adenine dinucleotide to generate an
6 alcohol, and
7 recovering the generated alcohol.

1 20. The method of claim 19, wherein the microorganism is the transformant of
2 claim 11.

1 21. The method of claim 17, wherein the ketone is 2,3-butanedione and the
2 alcohol is (2R,3R)-2,3-butanediol.

1 22. The method of claim 18, wherein the ketone is 2,3-butanedione and the
2 alcohol is (2R,3R)-2,3-butanediol.

1 23. The method of claim 19, wherein the ketone is 2,3-butanedione and the
2 alcohol is (2R,3R)-2,3-butanediol.